

The Influence of Strong Ion-Dipole Interactions on the Macroscopic and Microscopic Phase Behavior of Binary Polymer Blends (Invited)

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Strong attractive intermolecular interactions can improve the miscibility of two polymers. Although polystyrene and polyamides are highly immiscible, modest sulfonation of the polystyrene and neutralization with a metal cation produces a strong ion-dipole interaction between the resulting ionomer and the carbonyl group of the polyamide. The strength of that interaction depends on the cation used to form the sulfonated polystyrene (SPS) ionomer. Blends of lithium-neutralized SPS (Li-SPS) and a N-methylated polyamide 2,10 (mPA) exhibit single glass transitions and lower critical solution temperature (LCST) behavior as determined by light scattering. The LCST increases with increasing sulfonation due to the increased concentration of ion-dipole complexes. Polymer-polymer interaction parameters (χ) determined by the application of the random phase approximation to small angle neutron scattering (SANS) are negative, which is consistent with the observation of miscibility, and generally decrease with increasing sulfonation level, which is also consistent with improved miscibility as the concentration of interacting sites increase. However, the SANS data also reveal a correlation length in these blends on the order of 10-30 nm, which suggests that the blends are microphase separated. The correlation length determined by SANS decreases with increasing sulfonation level of the ionomer and no peak was observed in the structure factor when the sulfonation level was 20 mol%. In this talk, we will describe the macroscopic phase behavior of these blends as determined by light scattering and the microscopic phase behavior probed by SANS. We will discuss the origin of the microphase separation, as well as the limitations to the application of the random phase approximation in the calculation of χ .